REFERENCES

Albee, A.L., 1962, Relationships between the mineral association, chemical composition and physical properties of the chlorite series: Am. Mineralogist, 47, 851-870.

Ames, L.L. Jr., 1961, Volume relationships during replacement reactions: Econ. Geol., 56, 1438-1445.

Ames, R.L., 1962, Sulphur isotope study of the Tintic mining districts, Utah: Unpublished Ph.D. dissertation, Yale University.

Aw, P.C., 1967. Ignimbrites in central Kelantau, Malaya: Geol. Mag., 104, 13-18.

Babcock, R.S., 1973, Computational models of metasomatic processes: Lithos, 6, 279-290.

Bachinski, D.J., 1969, Bond strength and sulphur isotopic fractionation in coexisting sulphides: Econ. Geol., 64, 56-65.

Barnes, H.L., and Czamanske, G.K., 1968, Solubilities and transport of ore minerals: In Geochemistry of Hydrothermal Ore Deposits, H.L. Barnes (ed.), Holt, Rinehart and Winston, Inc., New York, p.334-381.

Bastin, E.S., 1950, Interpretation of ore textures: Geol. Soc. Amer. Mem., 45, 101p.

Bath, T.F.W., 1948, Oxygen in rocks: A basis for petrographic calculations: Jour. Geology, 56, 50-60.

_____ , 1959, Principles of classification and norm calculations of metamorphic rocks: J. Geol., 67, 135-152.

Becker, R.H., and Clayton, R.N., 1972, Carbon isotopic evidence for the origin of a banded iron-formation in Western Australia: Geochim. et Cosmochim. Acta, 36, 577-596.

Berry, L.G., 1940, Studies of mineral sulphosalts IV - Galenobismutite and "Lillianite": Univ. Toronto, Geol. Ser., 44, 5-19.

_____ , and Thompson, R.M., 1962, X-ray powder data for ore minerals: the Peocock Atlas: Geol. Soc. Amer., Mem. 85.

Bishop, D.G., 1972, Transposition structures associated with cleavage formation in the Otago schists: N.Z. Jour. Geol. Geophys., 15, 360-371.

Blank, R.H., 1962, Ignimbrite vent in the Bull Valley District, Utah (abs.): Geol. Soc. Amer., spec. paper 73, 27p.

Bodechtel, J. and Klemm, D.D., 1966, Uber die lagerstattenkundliche Stellung und chemische Zusammensetzung der Bleiwismutspiessglanze. Geol. Rundschan., 55, 418-427.

Borisenko, L.F., Lebedeva, S.I., and Serdobova, L.I., 1969, Titanium magnetite and magnetite in iron ore deposits of different genesis: Int. Geol. Rev., 11, 1408-1418.

Boydell, H.C., 1925, The role of colloidal solutions in the formation of mineral deposits. Bull. Inst. Min. Metall. 243, 1-108.

Brown, G., 1955, The effect of isomorphous substitutions on the intensities of 001 reflections of mica and chlorite type structures. Mineral Mag., 30, 657-665.

Burst, J.F. Jr., 1969, Diagenesis of Gulf Coast Clayey sediments and its possible relation to petroleum migration: Am. Assoc. Petrol. Geo. Bull., 53, 73-93.

Cherapanov, V.A., 1951, Aspects of morphology structure and substitution of malachite aggregates from Urals, deposits: Zap. Vses. Min. obs, 18, 3, 214-219. (In Russian, quoted by Chukhrov, 1965)

Chukhrov, F.V., 1965, Present views on colloids in ore formation. Int. Geol. Rev., 8, 3, 336-346.

_____ , 1973, On the genesis problem of thermal sedimentary iron ore deposits: Mineralium Deposita, 138-147.

Clayton, R.N., Friedman, I., Graf, D.O., Mayeda, T.A., Meets, W.F., and Shimp, N.F., 1966, The origin of saline formation waters I. Isotopic composition: J. Geophys. Res., 71, 3869-3882.

Cook, H.E., 1968, Ignimbrite flows, plugs and dykes in the southern part of the Hot Creek Range, Nye County, Nevada: Geol. Soc. Amer. Mem., 116, 107-152.

Craig, H., 1963, The isotopic geochemistry of water and carbon in geothermal areas: In Nuclear Geology in Geothermal Areas, E. Tongiorgi (ed.), Consiglio Nazionale delle Richerche, Pisa, p.17-53.

_____ , 1966, Isotopic composition and origin of the Red Sea and Salton Sea geothermal brines: Science, 154, 1544-1548.

Craig, J.R., 1967, Phase relations and mineral assemblages in the Ag-Bi-Pb-S system: Mineralium Deposita, 1, 278-306.

Crohn, P.W., and Oldershaw, W., 1965, The Geology of the Tennant Creek One Mile Sheet Area, N.T.: Bur. Min. Resour. Aust. Rep. 83, 72p.

Davidson, A., and Wyllie, P.J., 1965, Zoned magnetite and platy magnetite in Cornwall type ore deposits: Econ. Geol., 60, 766-771.

Deer, W.A., Howie, R.A., and Zussman, J., 1966, An introduction to the rock-forming minerals, Longmans, London, 528p.

Degens, E.T., and Epstein, S., 1962, Relationship between O^{18}/O^{16} ratios in coexisting carbonates, cherts, and diatomites: Amer. Assoc. Petrol. Geol. Bull., 46, 534-542.

Dickey, P.A., 1966, Patterns of chemical composition in deep subsurface waters: Am. Assoc. Petrol. Geol. Bull., 57, 265-273.

Drummond, A.D., Trotter, J., Thompson, R.M., and Gower, J.A., 1969, Neyite a new sulphosalt from Alice Arm. British Columbia. Can. Mineralgist, 10, 90-96.

Duffell, S., 1937, Diffusion and its relation to ore deposition: Econ. Geol., 32, 494-510.

Duncan, D.McP., 1970, Selected porphyroidal and granitic rocks at Tennant Creek, Northern Territory: Unpublished Ph.D. thesis, University of Tasmania.

Dunnet, D., and Harding, R.R., 1967, Geology of the Mount Woodcock 1-mile Sheet Area, Tennant Creek, N.T.: Bur. Min. Resour. Aust. Rep., 114, 57p.

Dunoyer de Segonzac, G., 1970, The transformation of clay minerals during diagenesis and low grade metamorphism: A review: Sedimentology, 16, 281-356.

D'yachkova, I.B., and Khodakovskiy, I.L., 1968, Thermodynamic equilibria in the systems S-H_2O, Se-H_2O, and Te-H_2 in the 25-300°C temperature range and their geochemical interpretations: Geochem. Int., 5, 1108-1125.

Dymkin, A.M., and Sokolov, G.A., 1961, Colloform segregations of endogenous magnetite in the Kurshunkul' Deposits. Geol. i geofiz, 1, 77-85 (In Russian).

Edwards, A.B., 1955, The composition of the Peko Copper Orebody, Tennant Creek: Aust. Inst. Min. Met. Proc., 175, 55-82.

Ellis, A.J., 1967, The chemistry of some explored geothermal systems: in Geochemistry of Hydrothermal Ore Deposits, H.L. Barnes (ed.), Holt, Rinehart and Winston, New York, 465-514.

Elliston, J.N., 1960, Ore localisation by Preconsolidation Structures: Aust. Inst. Min. Met. Proc., 196, 29-50.

_____ , 1963, Sediments of the Warramunga Geosyncline. In Syntaphral Tectonics and Diagenesis: "Symposium". (S.W. Carey Convener), Geol. Dept. Univ. Tasmania, L1-L45.

_____ , 1966, The Genesis of the Peko Orebody: Aust. Inst. Min. Met. Proc., 218, 9-18.

_____ , 1968, Retextured Sediments: Intern. Geol. Congr. 23rd, Rept. Session, Pragne, 8, 85-104.

_____ , 1969, The genesis of some epigenetic type ore deposits: Cas. Mineral. Geol., 14, 129-139.

Engel, A.E.J., Clayton, R.N., and Epstein, S., 1958, Variations in isotopic composition of oxygen and carbon in Leadville limestone and in its hydrothermal and metamorphic phases: Jour. Geol., 66, 374-393.

Esquevin, R., 1969, Influence de la composition chimique des illites sur leur cristallinite: Bull. Centre. Rech. Pav.-S.N.P.A., 3, 147-154.

Eugster, H.P., and Wones, D.R., 1962, Stability relations of the ferruginous biotite, annite: J. Petrology, 3, 82-125.

Fander, H.W., 1966, Selenium at Peko and Cobar: AMDEL Bulletin (Australia), 2, 73-75

Fawcett, J.J., and Yoder, H.S., 1966, Phase relationships of chlorites in the system $MgO-Al_2O_3-SiO_2-H_2O$: Am. Mineralogist, 51, 353-380.

Fink, G., 1910, Bidrag till Sveriges Mineralogi: Ark. Kemi, Mineral, Geol., 3, No. 35, p.4.

Fischer, A.G., 1964, The lofer cyclothems of the Alpine Triassic, Bull. Kansas Geol. Surv., 169, 108-149.

Forbes, W.C., 1969, Unit-cell parameters and optical properties of talc on the join $Mg_3Si_4O_{10}(OH)_2$ - $Fe_3Si_4O_{10}(OH)_2$: Am. Mineralogist, 54, 1399-1408.

_____ , 1971. Iron content of talc in the system $Mg_3Si_4O_{10}(OH)_2$ - $Fe_3Si_4O_{10}(OH)_2$: Jour. Geology, 79, 63-74.

Frondel, C., 1938, Stability of colloidal gold under hydrothermal conditions: Econ. Geol., 33, 1-20.

Garrels, R.M., 1959, Rates of geochemical reactions at low temperatures and pressures: Researches in Geochemistry, V.I, P.A. Abelson (ed.), Wiley, New York.

_____ , and Christ, C.L., 1965, Solutions, Minerals and Equilibria, Harper and Row, New York, 450p.

_____ , Dreyer, R.M., and Howland, A.L., 1949, Diffusion of ions through intergranular spaces in water-saturated rocks: Geol. Soc. Amer. Bull., 60, 1809-1828.

Goldschmidt, V.M., and Strock, L., 1935, Zur Geochemie der Selen. II: Nachr. Ges. Wiss. Gottingen, Math-Nat. Kl., N.F. Fachgr., 1, 123-142.

Goldsmith, R.J., and Newton, R.C., 1969, P-T-X relations in the system $CaCO_3$-$MgCO_3$ at high temperatures and pressures: Am. J. Sci., 276A 160-190.

Goleva, G.A., and Lushnikov, V.V., 1967, Occurrence of Selenium in the groundwaters of ore deposits and in some types of mineral waters: Geochem. Int., 4, 378-385.

Goni, J., Guillemin, C., and Sarcia, C., 1967, Geochimie der l'or exogene - Etude experimentale de la formation des dispersions colloidales d'or et de leur stabilite: Mineralium Deposita, 1, 259-268.

Goodwin, A.M., 1956, Facies relations in the Gunflint iron formation: Econ. Geol., 51, 565-595.

Goulevitch, J., (in press, April 1974), Geology and Structural Control at the Warrego Mine: in Economic Geology of Australia and Papua New Guinea (Metalliferous Volume): Melbourne, Aust. Inst. Min. Metal.

Graham, A.R., 1950, Synthesis and X-ray study of compounds in the systems Pb-Bi-S, Ag-Bi-S and Ag $(Bi,Sb_2)S_2$. Unpublished Ph.D. Thesis, Univ. of Toronto. 100p.

_____ , Thompson, R.M., and Berry, L.G., 1953, Studies of mineral sulphosalts: XVII: Cannizzarite:Am. Mineralogist, 38, 536-544.

Grigor'ev, D.P., 1965, Ontogeny of Minerals: Israel Program for Scientific Translations, Jerusalem, 250p.

Grinenko, V.A., and Grinenko, L.N., 1967, Fractionation of sulphur isotopes in high temperature decomposition of sulphides by water vapour: Geochemistry Int., 4, 843-848.

Grip, E., and Wirstam, A., 1970, The Boliden Sulphide deposit, A review of geo-investigations carried out during the lifetime of the Boliden Mine, Sweden (1924-1967). Sver. Geol. Unders., Ser. C, No. 651.

Gross, G.A., 1970, Nature and occurrence of iron deposits. In Survey of World Iron Ore Resources, United Nations Dept. Econ. Social Affairs, New York.

Gruner, J.W., 1934, The crystal structure of talc and pyrophyllite: Zeit. Krist., 88, 412-419.

_____ , 1944, The composition and structure of Minnesotaite, A common iron silicate in iron formations: Am. Mineralogist, 29, 363-372.

Hall, W.E., and Friedman, I., 1963, Composition of fluid inclusions, Cave-in-Rock fluorite district, Illinois, and Upper Mississippi Valley, Zinc-lead district: Econ. Geol., 58, 886-911.

_____ , 1969, Oxygen and carbon isotopic composition of ore and host rock of selected Mississippi Valley deposits: U.S. Geol. Survey Prof. Paper, 650-C, C140-C148.

Haranczyk, Czeshaw, 1969, Non colloidal origin of colloform textures, (discussion): Econ. Geol., 64, 466-468.

Harris, D.C., and Owens, D.R., 1973, Berryite, a Canadian occurrence. Can. Mineralogist, 11, 1016-1018.

Healey, T.W., 1972, Research in colloid and surface chemistry - Physiochemical processes in the diagenesis of sediments: Unpublished report, University of Melbourne, Department of Physical Chemistry, 103p.

Heinrich, K.F.J., 1966, X-ray absorption uncertainty. In: The Electron Microprobe, New York, J. Wiley & Sons, 296-377.

Helgeson, H.C., 1964, Complexing and hydrothermal ore deposition, International series of Monographs on earth Sciences, Pergamon Press, Oxford, 128p.

_____ , 1967, Solution chemistry and metamorphism: in Researches in Geochemistry, V.II, Abelson, P.H. (ed.), John Wiley & Sons, New York, 362-404.

_____ , 1968, Geologic and thermodynamic characteristics of the Salton Sea geothermal system: Am. J. Sci., 266, 129-166.

_____ , 1969, Thermodynamics of hydrothermal systems at elevated temperatures and pressures: Am. J. Sci., 267, 729-804.

_____ , 1970, A chemical and thermodynamic model of ore deposition in hydrothermal systems. In, Fiftieth Anniversary Symposia: Mineralogy and Petrology of the Upper Mantle, Sulphides. Mineralogy and Geochemistry of Non-Marine Evaporites. Mineral. Soc. Amer. Spec. Pap. 3, 155-186.

_____ , Brown, T.H., and Leeper, R.H., 1969, Handbook of Theoretical Activity Diagrams Depicting Chemical Equilibria in Geologic Systems Involving Minerals and an Aqueous Phase at one atm. and 0°-300°C., Freeman, Cooper, and Co., San Francisco, 253p.

_____ , and Garrels, R.M., 1968, Hydrothermal transport and deposition of gold: Econ. Geol., 63, 622-635.

Hemley, J.J., and Jones, W.R., 1964, Chemical aspects of hydrothermal alteration with emphasis on hydrogen metasomatism: Econ. Geol., 59, 538-569.

Henley, K.J., 1971, Mineralogical investigation of bismuth losses in Juno testing. Unpublished Amdel Report, (No. 750).

_____ , Radke, F., and Schultz, P.K., 1971, Mineralogical investigation of seven samples of Juno concentrates. Unpublished Amdel Report, (No. 820).

_____ , and Schultz, P.K., 1972, The Bi-Pb-(Cu)-S-Se Mineral in the Juno orebody, Tennant Creek. Paper presented at Specialist Meeting of Geol. Soc. Aust., February, 1972.

Hey, M.H., 1954, A new review of the chlorites: Mineral Mag., 30, 277-292.

Holser, W.T., 1947, Metasomatic processes: Econ. Geol., 42, 384-395.

_____ , and Schneer, C.J., 1961, Hydrothermal magnetite: Geol. Soc. Amer. Bull., 72, 369-386.

Irving, J.D., 1911, Replacement ore-bodies and the criteria for their recognition: Econ. Geol., 6, 527-561, 619-669.

Ivanac, J.F., 1954, The Geology and Mineral Deposits of the Tennant Creek Gold-Field, N.T.: Bur. Min. Resour. Aust. Bull. 22, 164p.

Ivanov, S.N., 1969, Factors in the Genesis of Hydrothermal Ore Deposits: Dokl. Akad. Nauk. SSSR., 186, 30-32.

James, H.L., 1954, Sedimentary facies of iron formation: Econ. Geol., 49, 235-293.

_____ , 1966, Chemistry of the iron-rich sedimentary rocks, U.S. Geol. Surv. Prof. Pap., 440-W, 61p.

Jensen, M.L., 1965, The rational and geological aspects of solid diffusion, Can. Mineralogist, 8, 271-290.

Jensen, M.L., 1967, Sulphur isotopes and mineral genesis: in, Geochemistry of Hydrothermal Ore Deposits; H.L. Barnes (ed.), Holt, Rinehart and Winston, New York, 143-165.

Jirgensons and Straumanis, 1954, A short textbook on Colloid Chemistry, Pergamon Press, Oxford. 500p.

Johansson, K., 1924, Bidrag till Gladhammar-gruvornas mineralogi. Ark. Kemi, Mineral., Geol., 9, No. 8, 1-22.

_____ , 1924a, Ett par selenförandee mineral från Falu gruva. Ark. Kemi, Mineral., Geol., 9, No. 8, 22-28.

Jones, G.J., 1970, The geology of Gecko Mine, Tennant Creek: paper presented at Geopeko Technical Seminar, King Island, 1970.

Jones, P.H., 1968, Hydrodynamics of geopressure in the northern Gulf of Mexico Basin: Amer. Inst. Min. Eng. Mtg. Spec. Pap., 2207, 12.

Kalocsai, G.I.Z., (in prep.), Precipitation of gold from aqua regia solutions and subsequent determination by atomic absorption.

Kaplan, I.R., Emery, K.O., and Rittenberg, S.C., 1963, The distribution and isotopic abundance of sulphur in recent marine sediments off southern California: Geochim. et Cosmochim. Acta, 27, 297-331.

Karup-Møller, S., 1966, Berryite from Greenland, Can. Mineralogist, 8, 414-423.

_____ , 1970, Gustavite, a new sulphosalt mineral from Greenland, Can. Mineralogist, 19, 175-190.

_____ , 1970a, Weibullite, laitakarite and bismuthinite from Falun Sweden. Geol. Foeren, Stockholm, Foerh, 92, 181-187.

_____ , 1972, New data on pavonite, gustavite, and some related sulphosalt minerals: Neues Jahrb. Mineral., Abh., 117, No. 1, 19-38.

Kelso, P., (in press), Bismuth backgrounds, Tennant Creek, Northern Territory: Jour. Geochem. (Aust.)

Keith, M.L., and Weber, J.N., 1964, Carbon and oxygen isotopic composition of selected limestones and fossils: Geochim. et Cosmochim. Acta, 28, 1787-1816.

Kennedy, G.C., 1950, A portion of the system silica-water: Econ. Geol., 45, 629-653.

Kharaka, Y.K., Berry, F.A.F., and Friedman, I., 1973, Isotopic composition of oil-field brines from Kettleman North Dome, California, and their geologic implications: Geochim. et Cosmochim. Acta, 37, 1899-1908.

Kingston, P.W., 1968, Studies of mineral sulphosalts: XXI - Nuffieldite, a new species: Can. Mineralogist, 9, 439-452.

Kitahara, S., 1960, The solubility of quartz in water at high temperatures and high pressures: Rev. Phys. Chem. Japan, 30, 109-114.

Klominsky, J., Reider, M., Keift, C., and Mraz, L., 1971, Heyrovskyite, $6(Pb_{0.86}Bi_{0.08}(Ag,Cu)_{0.04})$ S. Bi_2S_3 from Hurky, Czechoslovakia, a New Mineral of Genetic interest. Mineralium, Deposita, 6, 133-147.

Klyakhin, V.A., and Dmitriyeva, M.T., 1968, More information about synthetic and natural lillianite. Dokl. Akad. Nauk. SSSR, 178, 173-175.

Kodera, M., Kupcik, V., and Makovicky, E., 1970, Hodrushite - a new sulphosalt: Mineral. Mag., 37, 641-648.

Kolonin, G.R., and Aksenova, T.P., 1970, Investigation of complexing of some heavy metals in NaCl solutions at 20-90°C: Geochem. Int., 11, 973-978.

Kopeykin, V.A., and Mikhaylov, A.S., 1970, Solubility and forms of occurrence of silica in normal dilute solutions: Dokl. Akad, Nauk, SSSR, 191, 193-195.

Korzhinskii, D.S., 1955, An outline of metasomatic processes: in Basic problems in the study of magmatogenic deposits, Academy of Sciences of the U.S.S.R. (Translated in Int. Geol. Rev., 6, 1964; 1713-1734, 1920-1952 and 2169-2198.)

_____, 1957, Acidity conditions in post-magmatic solutions: Izv. Akad. Nauk. SSSR., Ser. Geol., 12, 3-12 (in Russian).

_____, 1959 The advancing wave of acidic components in ascending solutions and hydrothermal acid-base differentiation: Geochim. et Cosmochim. Acta, 17, 17-20.

_____, 1964, A theory of the process of mineral formation: Int. Geol. Rev., 6, 387-398.

_____ , 1968, The theory of Metasomatic Zoning: Mineralium Deposita, 3, 222-231.

_____ , 1970, Theory of Metasomatic Zoning, Clarendon Press, Oxford, 162p.

Kostov, I., 1958, Bonchevite, $PbBi_4S_7$, a new mineral: Mineral. Mag., 31, 821-828.

Krauskopf, K.B., 1951, The solubility of gold: Econ. Geol., 46, 858-870.

_____ , 1956, Dissolution and precipitation of silica at low temperatures: Geochim. et Cosmochim. Acta, 10, 1-26.

_____ , 1964, Possible role of volatile metal compounds in ore genesis. Econ. Geol., 59, 22-45.

Lakin, H.W., 1965, Geochemistry of selenium in relation to agriculture: U.S. Dept. Agr. Hankbk., 200, 3-12.

Landa, E.R., and Gast, R.G., 1973, Evaluation of crystallinity in hydrated ferric oxides: Clays and Clay Minerals, 21, 121-130.

Lapukhov, A.S., 1966, Diffusion transfer of material in fissures and through the intergranular spaces of water-saturated rocks: Geologuya Geofiz. Novosibirsk, 12, 56-64 (in Russian).

Large, R.R., 1971, Metasomatism and scheelite mineralisation at Bold Head, King Island: Aust. Inst. Min. Met. Proc., 238, 31-45.

_____ , 1971a, Regional Mapping in the Queen of Sheba, Three Ways, Whippet Area: Unpublished company Report, Geqpeko, Ltd.

_____ , 1972, Metal Zonation at Tennant Creek and its use as a guide in surface and underground exploration: Unpublished Company Report, Geopeko Ltd.

Lasky, S.G., 1930, A colloidal origin of some of the Kennecott ore minerals: Econ. Geol., 25, 737-757.

Lebedev, L.M., 1967, Metacolloids in endogenic deposits. Monographs in Geoscience, R.W. Fairbridge (ed.), Plenum Press, New York, 298p.

Levorsen, A.L., 1967, Geology of Petroleum: W.H. Freeman and Co., San Francisco, 723p.

Lindgren, W., 1912, The nature of replacement: Econ. Geol., 7, 521-535.

_____ , 1925, Gel replacement a new aspect of metasomatism. Nat. Acad. Sci., Proc., 11, 5-11.

_____ , 1933, Mineral Deposits, McGraw-Hill, New York, 930p.

Lindstrom, G., 1887, Title Unknown: Geol. Foeren, Stockholm Foerh., 9, 523.

Lovering, T.S., 1949, Rock alteration as a guide to ore - East Tintic District, Utah: Econ. Geol., Monograph 1, 64p.

Mackenzie, R.C., amd Meldan, K., 1959, The ageing of sesquioxide gels (1) Iron Oxide gels: Mineral Mag., 32, 153-165.

Makovicky, E., and Maclean, W.H., 1972, Electron Microprobe analysis of Hodrushite: Can. Mineralogist, 11, 504-513.

McCrea, J.M., 1950, The isotopic chemistry of carbonates and a paleo-temperature scale: Jour. Chem. Physics, 18, 849-857.

McNeil, R.D., 1963, Slip complexes in the Warramunga Geosyncline: in Syntaphral Tectonics and Diagenesis. "Sumposium". (S.W. Carey Convener), Geol. Dept. Univ. Tasmania, M1-M11.

_____ , 1966, Geology of the Orlando Mine, Tennant Creek, Australia: Econ. Geol., 61, 221-242.

Malashin, V.A., 1968, Differentiation of matter in the stage of dispersive metasomatism: Dokl. Akad, Nauk. SSSR., 182, 1406-1409.

Marakushev, A.A., and Perchuk, L.L., 1970, On the influence of the acidity and temperature of postmagmatic solutions on the composition of micas and chlorite, Union. Geol. Sci. A. No. 2: Problems of Hydrothermal Ore Deposition, Schweizerbart, Stuttgart, 274-278.

Marowsky, G., and Wedepohl, K.H., 1971, General trends in the behaviour of Cd, Hg, Tl and Bi in some major rock forming processes: Geochem. et Cosmochim. Acta, 35, 1255-1267.

Martin, R.F., and Piwinskii, A.J., 1969, Experimental data bearing on the movement of iron in an aqueous vapor: Econ. Geol., 64, 798-803.

Maxwell, J.C., 1962, Origin of slatey and facture cleavage in the Delaware Water Gap area, New Jersey and Pennsylvania. In Engel, A.E.J., Jones, H.L., ad Leonard, B.F., (eds.), Petrologic Studies: A volume in honour of A.F. Buddington: Geol. Soc. Amer., 660p.

Meyer, C., and Hemley, J.J., 1968, Wall Rock Alteration: in, Geochemistry of hydrothermal ore deposits, H.L. Barnes (ed.), Holt, Rinehart and Winston, New York, 166-235.

Moench, R.H., 1966, Relation of S_2 schistosity to metamorphosed clastic dykes, Rangeley - Phillips area, Maine: Geol. Soc. Amer. Bull., 77, 1449-1462.

Milsom, J.S., and Finney, W.A., 1965, Tennant Creek Detailed Aeromagnetic Survey, Northern Territory: Bur. Min. Resour. Aust. Rec. 1965/50 (unpubl.).

Minster, E.F., 1967, Benjaminite - $(Cu,Ag)_2Pb_2Bi_4S_9$: Dokl. Akad. Nauk. SSSR, 194, 675-678.

Moore, E.S., 1932, A magnetite vein of abnormal type: Econ. Geol., 27, 387-390.

Moore, P.B., 1967, A classification of sulphosalt structures derived from the structure aikinite: Am. Mineralogist, 52, 1874-1876.

Morse, H.W., Warren, C.H., and Donnay, J.D.H., 1932, Artificial spherulites and related aggregates: Am. J. Sci., 23, 421-439.

Naboko, S.I., 1959, Volcanic exhalations and products of their reactions as exemplified by the Kamchatka-Kuriles volcanoes: Bull. Volcanol., 20, 121-136.

Nockolds, S.R., 1966, The behaviour of some elements during fractional crystallisation of magma: Geochim et Cosmochim. Acta., 30, 267-278.

Northrop, D.A., and Clayton, R.N., 1966, Oxygen-isotope fractionations in systems containing dolomite: Jour. Geol., 74, 174-196.

Nowacki, W., and Stalder, H.A., 1969, Zwei Wismutsulfosalze von Sta. Maria. Val. Medel, Mt. Graubunden, Schweiz, Schweiz Mineral. Petrog. Mitt., 49, 97-101.

Nuffield, E.W., and Harris, D.C., 1966, Studies of mineral sulphosalts: XX: Berryite, a new species: Can. Mineralogist, 8, 407-413.

Odman, O.H., 1941, Geology and Ores of the Boliden deposit, Sweden. Sver., Geol. Unders., Ser. C, No. 438,

Oertel, A.C., 1970. The Calculation of results in electron-probe micro-analysis. C.S.I.R.O. Aust. Div. Soils Tech. Pap., 9, 20p.

Ohmasa, M., and Nowacki, W., 1970, Note on the space group and on the structure of aikinite derivatives: Neues Jahrb. Mineral. Monatsh., 1970, 158-162.

Ohmoto, Hiroshi, 1972, Systematics of sulphur and carbon isotopes in hydrothermal ore deposits: Econ. Geol., 67, 551-578.

Ontoev, D.O., Troneva, N.V., and Tsepin, A.I., 1972, Argentiferous wittite from eastern Trans-Baikal: Zap, Vses. Mineral. Obshchest., 101. 476-480 (in Russian).

Ontoyev, D.O., 1959, Colloform magnetite and the distinctive platy and tabular pyrite segregations in magnetite ores: Tr. Mineral, muzei. Akad, Nauk, SSSR., 9, 74-85 (In Russian).

O'Neil, J.R., Clayton, R.N., and Mayeda, T., 1969, Oxygen isotope fractionation in divalent metal carbonates: Jour. Chem. Physics, 51, 5547-5558.

Otto, H.H. and Strunz, H., 1968, Zur Kristallchemie Synthetischer Blei-Wismut-Spiessglanze. Neues Jahrbs. Mineral., Abh., 108, 1-19.

Padera, K., 1956, Beitrag zur Revision der Mineralien aus der Gruppe von Wismutglanz und aikinit: Chem. Erde, 18, 14-18.

Papson-McGugan, J.E., 1970, The diagenesis and depositional environment of the Permian Ranger Canyon and Mowitch Formations, Ishbel Group, from the Southern Canadian Rocky Mountains: Sedimentology, 15, 363-418.

Park, C.F., and MacDiarmid, R.A., 1970, Ore Deposits, 2nd Edition, W.H. Freeman, San Francisco.

Pavlov, N.V., 1958, Problems of the genesis of the Endogenetic Magnetite ores of the Fungusska Syneclise on the Siberian Platform: Izv. USSR. Acad. Sci., Ser. Geol., (1958), 9, 1-17.

Peacock, M.A., and Berry, L.G., 1940, Rontgenographic Observations on ore minerals. Univ. Toronto, Geol. Ser., 44, 47-69.

Perry, D.V., 1969, Skarn genesis at the Christmas Mine, Gila County, Arizona: Econ. Geol., 64, 255-271.

Perry, E.A., and Hower, J., 1972, Late stage dehydration in deeply buried pelitic sediments: Am. Assoc. Petrol. Geol. Bull., 56, 2013-2020.

Pettijohn, F.J., 1963, Chemical Composition of Sandstones - excluding Carbonate and Volcanic Sands. U.S. Geol. Surv. Prof. Pap., 440-S, 21pp.

Petruk, W., 1964, Determination of the heavy atom content in chlorite by means of the X-ray diffractometer: Am. Mineralogist, 49, 61-71.

Pinckney, D.M., and Rye, R.O., 1972, Variation of O^{18}/O^{16}, C^{13}/C^{12}, Texture and mineralogy in altered limestone in the Hill Mine, Cave-in-District, Illinois: Econ. Geol., 67, 1-18.

Plotnikov, V.I., 1959, Separation of Se^{IV} by means of iron hydroxide. Zavodskaya laboratoriya, 6, (in Russian).

Poldervaart, A., 1953, Petrological calculations in metasomatic processes: Am. J. Sci., 251, 481-504.

Pospelov, G.I., 1966, The types and mechanisms of metasomatism: Int. Geol. Rev., 9, 890-898.

Powell, C.McA., 1969, Intrusive sandstone dykes in the Siamo Slate near Negamee, Michigan: Geol. Soc. Amer. Bull., 80, 2585-2594.

_____ , 1972, Tectonically dewatered slates in the Ludlovian of the Lake District, England: Geol. Jour., 8, 95-110.

Ramdohr, Paul, 1969, The ore minerals and their intergrowths. English trans., (Amstutz C.H.R., Ed.) Pergannon Press, 1174p.

Randal, M.A., Brown, M.C., and Doutch, H.F., 1966, Geology of the Helen Springs and Beetaloo 1:250,000 sheet areas, N.T., Bur. Min. Resour. Aust., 1966/110 (unpubl.)

Ridge, J.D., 1968, Changes and Developments in Concepts of Ore Genesis, in Ore Deposits of the United States, 1933-1967, J.D. Ridge (ed.), 1713-1834.

Roedder, E., 1967, Fluid inclusions as samples of ore fluids: in, Geochemistry of Hydrothermal Ore Deposits, H.L. Barnes (ed.), Holt, Rinehart and Winston, New York, 515-574.

_____ , 1968, The non colloidal origin of "colloform" textures in sphalerite ores: Econ. Geol., 63, 451-471.

Rogers, A.F., 1917, A review of the amorphous minerals: Jour. Geology, 25, 515-541.

Romberger, S.B., 1968, Solubility of copper in aqueous sulphide solutions coexisting with covellite from 25° to 200°C, with geologic applications: Unpublished Ph.D. Thesis, The Pennsylvania State Univ.

Rundkvist, D.V., 1958, Morphological and internal structural features of mineral aggregates in near-surface tin ore deposits: Zap. Vses. Min. obs, 87, 423-439. (In Russian, quoted in Chukhrov, 1965.)

Rust, G.E., 1935, Colloidal primary copper ores at Cornwall Mines, S.E. Missouri: Jour. Geology, 43, 398-426.

Rye, R.O., 1966, The carbon, hydrogen, and oxygen isotope composition of the hydrothermal fluids responsible for the lead-zinc deposits at Providencia, Zacatecas, Mexico: Econ. Geol., 61, 1399-1427.

Sakai, H., 1968, Isotopic properties of sulphur compounds in hydrothermal processes, Geochim. J. (Nagoya), 2, 29-49.

Salanci, B., and Moh, G.H., 1969, Die experimentelle Untersuchung des pseudobinaren Schnittes $PbS-Bi_2S_3$ innerhalb des Pb-Bi-S-systems in Beziehung zu naturlichen Blei-Wismut-Sulfosalzen. Neues. Jahrb. Min., Abh., 112, 63-95.

Sales, R.H. and Meyer, C., 1950, Interpretation of wall-rock alteration at Butte, Montana. Colo. Sch. Mines Q., 45, (1B) 261-273.

Sangster, D.F., 1965, Colloform magnetite in a contact metasomatic iron deposit (discussion), Econ. Geol., 60, p.824-826.

_____, 1972, Precambrian volcanogenic massive sulphide deposits in Canada: A review: Geol. Surv. Can. Pap. 72-22, 44pp.

Schneiderholm, H., 1952, Erzmikroskopisches Praktikum: Stuttgart, 274p.

Schoen, R., 1962, Semi-quantitative analysis of chlorite by X-ray diffraction: Am. Mineralogist., 47, 1384-1393.

Seward, T.M., 1973, The complexes of gold and the transport of gold in hydrothermal ore solutions: Geochim. et Cosmochim. Acta., 37, 379-400.

Shannon, E.V., 1964, Benjaminite, a new sulphosalt mineral of the Klaprotholite group: U.S. Nat. Mus. Proc., 65, No. 24, 1-9.

Sheppard, S.M.F., Nielsen, R.L., and Taylor, H.P. Jr., 1971, Hydrogen and Oxygen isotope ratios in minerals from porphyry copper deposits: Econ. Geol., 66, 515-542.

_____, and Schwarcz, H.P., 1970, Fractionation between carbon and oxygen isotopes and magnesium between coexisting metamorphic calcite and dolomite: Contr. Mineral. Petrol., 26, 161-198.

Siever, R., 1962, Silica solubility, 0°-200°C, and the diagenesis of siliceous sediments: Jour. Geology, 70, 127-150.

Sillen, L.G., 1964, Stability constants of metal-ion complexes. Sec. I. Inorganic ligands: Chem. Soc. London Spec. Pub., 17.

Sindeeva, N.D., 1962, Mineralogy and types of Deposits of Selenium and Tellurium, Interscience Publishers, New York, 363p.

Skinner, B.J., White, D.E., Rose, H.J., and Mays, R.E., 1967, Sulphides associated with the Salton Sea geothermal brine: Econ. Geol., 62, 316-330.

Smith, F.G., and Kidd, D.J., 1949, Hematite-geothite relations in neutral and alkaline solutions under pressure; Am. Mineralogist, 34, 403-412.

Springer, G., and Demirosoy, S., 1969. Bertrag Zur Clarung der Existenz von Klaprothit. Neues, Jahrb. Mineral., Monatsh., 32-37.

Springer, G., 1971, The synthetic solid-solution series Bi_2S_3-$BiCuPbS_3$ (bismuthinite-aikinite): Neues Jahrb. Mineral., Monatsh., 1971, 19-24.

Stanton, R.L., and Rafter, T.A., 1966, The isotopic constitution of sulphur in some stratiform lead-zinc sulphide ores: Mineralium Deposita, 1, 16-29.

_____ , 1972, Ore Petrology, McGraw-Hill Book Company, New York, 712p.

_____ , 1972a, A preliminary account of chemical relationships between sulphide lode and "banded iron formation" at Broken Hill, New South Wales: Econ. Geol., 67, 1128-1145.

Stemprok, M., 1970, Continuity or Discontinuity of Processes leading to Wall-Rock Alteration in Problems of Hydrothermal Ore Deposition, Schweizrebart, Stuttgart 1970. (union Geol. Sci. A. No. 2.)

Stevenson, J.S., and Jeffrey, W.G., 1964, Colloform magnetite in a contact metasomatic iron deposit: Econ. Geol., 59, 1298-1305.

Strickland, C.S., (in press, April 1974), The Gecko Copper Mine, Tennant Creek: in Economic Geology of Australia and Papua New Guinea (Metalliferous volume): Melbourne, Aust. Inst. Min. Metal.

Sweatman, T.R., and Long, J.V.P., 1969, Quantitative electron-probe microanalysis of rock-forming minerals: J. Petrol, 10, 332-379.

Syritso, L.F., and Senderova, V.M., 1964, The problem of the existence of lillianite (in Russian): Zap. Vses. Mineral. Obshchest., 93, 468-471. (Ref. in: Mineral. Abstr. 17, 174-175).

Takagi, J., and Takeuchi, Y., 1972, Structural principles of the crystalline phases in the PhS-Bi_2S_3 system (Abstr), Acta Crystallographica, 28B, 566.

Taylor, H.P. Jr., 1967, Oxygen isotope studies of hydrothermal mineral deposits: in, Geochemistry of Hydrothermal Ore Deposits, H.L. Barnes (Ed.), Holt, Rinehart and Winston, New York, 109-142.

_____, Frechen, J., and Degens, E.T., 1967, Oxygen and carbon isotope studies of carbonatites from the Laacher See district, West Germany, and the Alno district, Sweden: Geochim. et Cosmochim. Acta, 31, 407-430.

Tilling, R.I., Gottfried, D., and Rowe, J.J., 1973, Gold abundance in igneous rocks: bearing on gold mineralisation: Econ. Geol., 68, 168-186.

Turner, F.J., 1968, Metamorphic Petrology, McGraw-Hill, New York, 403p.

Toulmin, P., and Clark, S.P. Jr., Thermal aspects of ore formation: in, Geochemistry of hydrothermal ore deposits, H.L. Barnes (Ed.), Holt, Rinehart and Winston, New York, 437-464.

Uytenbogaardt, W., and Burke, E.A.J., 1971, Tables for microscopic identification of ore minerals: Elsevier Publishing Company, Amsterdam, 430p.

Van Everdingen, R.O., 1970, The Paint Pots, Kootenay National Park, British Columbia - acid spring water with extreme heavy-metal content: Can. Jour. Earth Sci., 7, 831-852.

Van Hook, H.J., 1960, The ternary system Ag zS-Bi_2S_3-PbS: Econ. Geol., 55, 759-788.

Walters, L.J. Jr., Claypool, G.E., and Choquette, P.W., 1972, Reaction rates and δO^{18} variation for the carbonate-phosphoric acid preparation method: Geochim. et Cosmochim. Acta, 36, 129-140.

Weaver, C.E., and Beck, K.C., 1971, Clay water diagenesis during burial: how mud becomes gneiss: Geol. Soc. Amer. Spec. Pap., 134.

Wehrenberg, J.P., and Silverman, A., 1965, Studies of base metal diffusion in experimental and natural systems: Econ. Geol., 60, 317-350.

Weibull, M., 1885, Om selenhaltig galenobismutite from Falun grufva. Geol. Foeren, Stockholm Foerh., 96, 657-666.

Weissberg, B.C., 1970, Solubility of gold in hydrothermal alkaline sulphide solutions: Econ. Geol., 65, 551-556.

Welin, E., 1966, Notes on the mineralogy of Sweden. 5. Bismuth-bearing sulphosalts from Gladhammer, a revision: Ark. Mineral. Geol. 4, 377-386.

Wells, N., Selenium content of soil-forming rocks: N.Z. Jour. Geol. Geophys., 10, 198-208.

White, D.E., 1968, Environments of generation of some base-metal ore deposits: Econ. Geol., 63, 301-335.

_____, and Waring, G.A., 1961, A review of the chemical composition of gases from volcanic fumaroles and igneous rocks. U.S. Geol. Surv. Prof. Pap., 424-C, C311-312.

Whittle, A.W.G., 1966, The paragenesis and origin of the Tennant Creek Mineral Deposits. Unpub. Ph.D. thesis, University of Adelaide, 227p.

Williams, B.T., 1970, The Gecko mineral channel: paper presented at Geopeko Technical Seminar, King Island, 1970.

Willis, J.L., and Daly, M.R., 1972, Investigations within Jubilee No. 2 reserve 306, Tennant Creek, N.T. Geol. Surv. Rec., Mines Branch, Northern Territory Administration, Department of the Interior. 17pp.

Wolfe, C.W., 1938, Cannizzarite and bismuthinite from Vulcano. Am. Mineralogist, 23, 790-798.

Wright, K., 1969a, Textures from some epigenetic mineral deposits of Tennant Creek - Central Australia. Reprinted from meeting on remobilisation of ores and minerals, Cagliari, 1969, 219-251.

_____ , 1969b, The presence of uraninite in the mineral bodies of Tennant Creek field: Unpublished Company Report, Geopeko Ltd.

_____ , 1970, Geology and ore reserves of Ivanhoe Mine, Unpublished Company report, Geopeko Ltd.

Zies, E.G. 1929, The Valley of Ten Thousand Smokes - I. The fumarolic incrustations and their bearing on ore deposition. Tech. Pap. Natl. Geogr. Soc., 1, No. 4, 62-79.

Zelenov, K.K., 1960, Migration and accumulation of iron and aluminium in the volcanic areas of the Pacific Ocean. Izv. USSR. Acad. Sci. Ser. Geol., 8, 58-74.

Zharikov, V.A., 1965, The possible significance of electrokinetic phenomena in geochemistry: in Problems of geochemistry, Khitarov (Ed.), Science Press.

APPENDIX A

PROCEDURE USED IN THE CALCULATION OF NORMATIVE MINERALOGY

Due to the varied mineralogical composition of the lode rocks and country rocks, and the widespread variation in the composition of the chlorites present in these rocks, the usual normative calculation methods were inappropriate, and the following procedures were adopted in their place.

(a) Sedimentary Rocks: applies to norms presented in Tables 3.2, 3.3, 4.5 and 9.2. All the normative minerals except chlorite were taken to have their 'ideal composition' (used in the calculation of epinorms, Bath, 1959). Chlorite was given the formula

$$[(Mg,Fe)_{9.5}\ Al_{2.5}]\ [Al_{2.5}\ Si_{5.5}]\ O_{20}\ (OH)_{16}$$

In hematite bearing sediments free of magnetite, all the FeO, MnO and MgO was assumed to be present in chlorite. This allowed a ready calculation of the Fe+Mn/Fe+Mn+Mg ratio of the chlorite and determination of normative chlorite based on the composition given above. In magnetite bearing sediments free of hematite, FeO is present in both magnetite and chlorite. In such samples, the Fe_2O_3 content of the rock was used to calculate normative magnetite and the residual FeO was assumed to be in chlorite. Norms for rocks containing hematite, magnetite and chlorite could not be calculated unless a value for the Fe+Mn/Fe+Mn+Mg ratio of the chlorites was assumed (as is the case in col. 5, Table 3.3).

Normative albite was calculated directly from the Na_2O while normative apatite was calculated from the P_2O_5 content. Excess CaO not present in apatite or calcite was used to give normative anorthite, while normative calcite was calculated from the CO_2 content. K_2O and residual Al_2O_3 are present in both muscovite and K-feldspar whose normative values were calculated by solving the simultaneous equations:

$$\text{normative muscovite} = \frac{(16.9 \times \text{wt.\% } Al_2O_3) - (8.4 \times \text{wt.\% } K_2O)}{433}$$

$$\text{normative K-feldspar} = \frac{\text{wt.\% } Al_2O_3 - 38.44 \text{ (norm. musc.)}}{18.35}$$

The norms obtained by this method gave good totals (100 ± 1%) and agree with visual estimates recorded during the microscopic study of the sediments.

(b) Lode Rocks: applies to norms presented in Tables 4.1 and 9.3.

The chloritised sediments at Juno and Gecko are free of magnetite and their normative mineralogy was calculated by the method described above for the magnetite free sediments.

The mineralised sediments at Juno contain magnetite, hematite and chlorite but no quartz. This residual SiO_2, Al_2O_3 and MgO left after the calculation of normative muscovite, albite and anorthite was considered to be present in chlorite. Assuming the formula given above, this allowed the calculation of normative chlorite and the percentage of FeO in chlorite. The remaining FeO and Fe_2O_3 were divided between magnetite and hematite.

The magnetite-chlorite lode rocks contain negligible muscovite and feldspars and thus normative chlorite was calculated directly from the total Al_2O_3 content of the rocks.

In the talc-magnetite zone, Al_2O_3 was assumed to be present only in chlorite, and the residual MgO was used to calculate normative talc. The latter mineral was given the formula $Mg_{5.5}Fe_{0.5}Si_8O_{20}(OH)_4$ although microprobe data (section 4.3.2) indicates a variable iron content throughout the zone - a factor which probably contributed to the poor totals given by norms in Table 4.1. Normative pyrite which only occurs in measurable quantities in the talc zone was calculated from the sulphur analysis after allowing for the other metal sulphides. Normative magnetite

was calculated from residual FeO and normative hematite from residual Fe_2O_3 (after accounting for pyrite and magnetite).

The normative mineralogy of the dolomite zone was calculated in a similar manner to the other zones. Dolomite was split into four components ($CaCO_3$, $MgCO_3$, $MnCO_3$ and $FeCO_3$) and CO_2 was partitioned amongst these according to the residual amounts of the metal oxides.

APPENDIX B

ADDITIONAL GEOCHEMICAL DATA ON CARRAMAN FORMATION GREYWACKE AND SHALES

Analyses by Australian Mineral Development Laboratories

JUNO	Cu	S	Se ppm
UNALTERED SEDIMENTS			
DDH 9/71/30-34	45	300	<2
51-55	70	500	<2
67-71	200	500	<2
113-117	25	1600	<2
276-280	5	450	<2
381-385	5	450	<2
451-455	15	650	<2
LEACHED SEDIMENTS			
DDH 9/71/137-141	5	300	<2
164-168	35	1250	<2
214-218	<5	300	<2
EXPLORER 46			
UNALTERED SEDIMENTS			
DDH 46/4/3/291	5	250	<2
298	5	250	<2
307	15	200	<2
318	5	250	<2
334	100	300	<2
342	50	400	<2
353	5	300	<2
378	5	250	<2
391	50	350	<2
403	5	300	<2
WEST PEKO			
UNALTERED SEDIMENTS			
DDH 2A/1104	10	300	<2
1496	70	250	<2
1870	520	950	<2
2099	10	300	<2
2118	85	300	<2
2204	110	300	<2

APPENDIX C

ROCK SAMPLES LODGED AT UNIVERSITY OF NEW ENGLAND, AND GEOPEKO LTD., TENNANT CREEK.

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
			JUNO MINE	Bismuth sulphosalts
R27787a		GP 213	700 level	Junite in magnetite-chlorite rock
R27788a			700 level	Junite
R27789a			700 level	Junite and "wittite"
R27790			700 level	Junite
R27791a		GP 127	7/167/1**	Junite
R27792a		GP 204	8/166/73	Aikinite member
R27793a		GP 88	700 level	Wittite
R27794a		GP 112	7/89/13	Wittite
R27795a			700 level	Wittite
R27796a		GP 131	7/38/70	Heyrovskyite
R27797a		GP 173	7/26/125	Aikinite members
R27798a			7/92/33	Aikinite + junite
R27799a		GP 178	7/25/130	Aikinite members
R27800a			8/170/42	Junite
R27801a			7/26/91	Emplectite
R27802a			700 level	Junite + aikinite
			WHIPPET FORMATION	
	GT 377		N.E. of Three Ways	Massive Sandstone
	GT 1307		Whippet Trig Station	Massive Sandstone
		GP 478	Whippet Trig Station	Massive Sandstone

* Indicates a thin section in addition to hand specimen lodged at U.N.E.
a Indicates a polished section in addition to hand specimen lodged at U.N.E.
** 7/167/1 ≡ 700 level, DDH No. 167, 1 foot from collar.

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
			BERNBOROUGH FORMATION	
	GT 376		Bernborough Area	Crystal-vitric tuff
	GT 471		North of Whippet Trig	Crystal-vitric tuff
	GT 481		Bernborough Area	Crystal-vitric tuff
	GT 442		North of Whippet Trig	Laminated rhyolite
	GT 311		Bishops Creek	Pumice rich tuff
			CARRAMAN FORMATION	
R27803			Explorer 86	Magnetic siltstone
R27804	GT 1234		Explorer 86	Magnetic siltstone
R27805			Explorer 46	Greywacke
R27806			Explorer 46	Chloritic siltstone
R27807	GT 1245		Explorer 46	Greywacke/hematite shale
R27808	GT 1404		West Peko	Hematite siltstone
R27809	GT 284		3/4 km north of Golden Forty Mine	Peko porphyry
R27810*			as above	Peko porphyry
R27811*			as above	Peko porphyry
R27812*			as above	Peko porphyry
R27813*			as above	Peko porphyry
R27814*			as above	Peko porphyry
R27815*			as above	Peko porphyry
R27816*			as above	Siltstone overlying porphyry
R27817*			as above	Greywacke overlying porphyry
R27818*			Jubilee area	Baveno Porphyry
R27819*			Station Hill	Massive porphyritic granite
R27820*	GT 284		3 kms south of Bernborough Mine	Porphyritic rhyolite (Phase A)
	GT 209		as above	as above
R27821	GT 110		as above	Intrusive ignimbrite (Phase B)

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
			JUNO	
R27822*			700 level	Basic dykes
R27823*			700 level	Basic dyke
R27824			7/114/207	Greywacke with shale inclusions
R27825*			7/178/13-19.5	Feldspathic greywacke
R27826*			7/178/45-51	Feldspathic Greywacke
R27827	GT 612		8/159/59-65	Coarse feldspathic greywacke
R27828*			7/178/19.5-27	Feldspathic greywacke-shale
R27829*			7/178/27-31	Chlorite-hematite-calcite bif.
R27830*			7/178/31-36	Chlorite-hematite-calcite bif.
R27831*			Surface DDH1	Chlorite-hematite-calcite bif.
R27832*			7/178/29	Chlorite-hematite-calcite bif.
R27833		GP	7/208/382	Chlorite-hematite-calcite bif.
R27834	GT 1211		7/208/148	Chlorite-hematite-calcite bif.
R27835			7/207/78	Chlorite-hematite-calcite bif.
R27836	GT 1198		7/136/46	Cherty siltstones
R27837	GT 1208		7/207/94	Cherty siltstones
R27838*			Surface DDH1.	Crystal tuff ?
R27839	GT 1209		7/208/126	Intraformational breccia
R27840			9/71/254	Tuffaceous greywacke/shale
R27841	GT 1216		9/73/306	Coarse tuffaceous greywacke
R27842	GT 1240		9/71/456	Coarse tuffaceous greywacke
R27843	GT 1238	GP 413	9/71/76	Tuffaceous greywacke-shale
R27844	GT 1251	GP 429	9/71/408	Tuffaceous greywacke-shale
R27845	GT 1248	GP 422	9/71/382	Magnetite rich shale
R27846		GP 416	9/71/110	Tuffaceous greywacke shale
R27847		GP 417	9/71/321	Tuffaceous greywacke shale
R27848	GT 876		7/25/44	Altered bif.
R27849*			700 level	Altered bif.
R27850	GT 1243		9/71/312	Greywacke/shale
R27851	GT 1271		9/75/769	Laminated magnetic shale
R27852*			8/128/5	Chloritised sediments adjacent to lode

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R27853*			8/128/13	Chloritised sediments adjacent to lode
R27854*a			8/128/21	Chloritised sediments adjacent to lode
R27855*			8/128/29	Chloritised sediments adjacent to lode
R27856*a			8/128/37	Chloritised sediments adjacent to lode
R27857*			8/128/45	Chloritised sediments adjacent to lode
R27858*a			8/128/53	Chloritised sediments adjacent to lode
R27859*a			8/128/67	Mineralised sediments
R27860*		GP 187	8/128/65	Mineralised sediments
R27861*a			8/128/69	Mineralised sediment
R27862*a			8/128/78	Mineralised sediment
R27863*a			8/128/85	Mineralised sediments
R27864a			8/128/80	Mineralised sediments
R27865*a			8/128/93	Magnetite-chlorite lode
R27866*a			8/128/101	Magnetite-chlorite lode
R27867*a			8/128/109	Magnetite-chlorite lode
R27868		GP 189	8/128/113	Magnetite-chlorite lode
R27869*a			8/128/117	Magnetite-chlorite lode
R27870*a			8/128/126	Magnetite-chlorite lode
R27871*a			8/128/133	Magnetite-chlorite lode
R27872*a			8/128/141	Talc-magnetite lode
R27873*a			8/128/149	Talc-magnetite lode
R27874*a			8/128/157	Talc-magnetite lode
R27875*a			8/128/165	Dolomite lode
R27876*		GP 203	8/128/169	Dolomite lode
R27877*a			8/128/173	Dolomite lode
R27878*a			8/128/189	Chloritised sediment
R27879*a			8/128/197	Unaltered sediment
R27880	GT 703		8/170/100	Partially chloritised sediment
R27881	GT 863		7/25/40	Partially chloritised sediment
R27882	GT 613		8/159/0-5	Chloritised sediment
R27883		GP 229	700 level	Magnetite-chlorite lode
R27884a			7/89/1	Magnetite-chlorite lode

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R27885a			7/89/31	Magnetite-chlorite lode
R27886a			7/89/59	Magnetite-chlorite lode
R27887		GP 150	7/38/50	Chalcopyrite ore
R27888		GP 168	7/38/98	Mineralised sediment
R27889		GP 162	7/38/140	Mineralised sediment
R27890		GP 171	7/38/155	Mineralised sediment
R27891		GP 170	7/38/200	Mineralised sediment
R27892		GP 151	7/176/172	Mineralised sediment
R27893	TS 880	GP 167	7/36/108	Magnetite-chlorite lode
R27894	TS 872	GP 156	7/36/117	Talc-magnetite lode
R27895		GP 428	9/71/690	Veins of mineralised sediment within hydrothermal channel
R27896		GP 407	9/73/845½	Veins of mineralised sediment within hydrothermal channel
R27897			700 level	Talc-magnetite rock
R27898			700 level	Talc-magnetite rock
R27899*		GP 137	7/167/21	Talc-magnetite rock
R27900*		GP 118	7/167/37	Talc-magnetite rock
R27901*			7/167/45	Talc-magnetite rock
R27902*		GP 130	7/167/69	Talc-magnetite rock
R27903*a			600 level	Banded dolomite
R27904*			7/30/300	Banded dolomite
R27905			600 level	Banded dolomite
R27906			700 level	Vein of banded dolomite
R27907a			7/90/69	Dolomite-jasper rock
R27908			7/89/5	Magnetite-chlorite lode
			GECKO MINE	
R27909	GT 1451		Anomaly 2 DDH22/484	Potassic greywacke/shale
R27910	GT 1447		DDH22/317	Intraformational breccia
R27911	GT 1449		DDH22/411	Intraformational breccia
R27912			2 level	Breccia-conglomerate

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R27913	GT 1374	GP 501	2 level	Breccia-conglomerate
R27914	GT 1380		2 level	Breccia-conglomerate
R27915	GT 1440		2/9180/5/24	Hematite shale
R27916			Anomaly 1	Hematite shale
R27917	GT 1437		2/9180/5/22/2	Hematite shale
R27918	GT 648		Anomaly 3	Hematite shale
R27919	GT 850		2/9180/3/85	Chloritised breccia-conglomerate
R27920	TS 837	GP 224	2/9180/3/171	Altered breccia-conglomerate
R27921	GT 1424	GP 554	2/9180/8/6.8	Altered breccia-conglomerate
R27922			2 level	Partially replaced breccia-conglomerate
R27923			2 level	Partially replaced breccia-conglomerate
R27924			2 level	Partially replaced breccia-conglomerate
R27925			2 level	Completely replaced breccia-conglomerate
R27926	GT 1477		4 level	Banded hematite-quartz lode
R27927		GP 249	2/9180/6/30	Massive hematite with chalcopyrite
R27928		GP 549	2/9180/8/8.2	Hematite-chlorite lode
R27929		GP 548	2/9180/8/17.5	Massive hematite
R27930		GP	Anomaly 2 DDH5/633	Quartz-hematite
R27931		GP 212	Anomaly 2 DDH7/758	Quartz-hematite
R27932		GP 256	2/9180/3/182.5	Quartz-hematite
R27933			4 level	Massive magnetite-chalcopyrite
R27934		GP 247	2/9180/6/185	Magnetite-chalcopyrite ore
R27935		GP 250	2/9180/6/141	Chalcopyrite ore
R27936		GP 245	2/9180/6/95	Magnetite-pyrite-chalcopyrite ore
R27937		GP 261	2/9180/6/162	Magnetite-chalcopyrite ore
R27938		GP 248	2/9180/6/66	Magnetite-chalcopyrite ore
R27939		GP 547	2/9180/8/30.8	Magnetite-chalcopyrite ore

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R27940		GP 539	2/9180/8/39.3	Magnetite-chalcopyrite ore
R27941		GP 553	2/9180/8/5213	Magnetite-bismuth ore
R27942		GP 541	2/9180/8/70.1	Massive magnetite
R27943		GP ?	2/9180/8/71.8	Magnetite-bismuth ore
R27944			Anomaly 2 DDH1/709	Magnetite-hematite lode
R27945		GP 220	2/9180/3/143	Magnetite-chlorite-chalcopyrite
R27946		GP 227	2/9180/3/139	Magnetite-chalcopyrite-pyrite
			GECKO ANOMALY 3	
R27947*			H3/339	Micro diorite
R27948*			H3/420	Hornfelsed sediment
R27949*			H3/557	Dolomite lode
R27950*			H3/610	Dolomite lode
R27951*			H3/623	Garnet-calcite rock
R27952*a			H3/749	Magnetite-bornite ore
R27953			H3/803	Magnetite-calcite
R27954a			H3/835	Magnetite-chalcopyrite ore
R27956*		GP 129	H3/847	Magnetite-calcite
R27957			H3/766	Magnetite-chalcopyrite-bornite ore
R27958			H3/905	Magnetite-dolomite
R27959			H3/942	Chlorite-magnetite-dolomite
R27960		GP 143	H3/964	Magnetite-chalcopyrite ore
R27961			H3/1006	Brecciated wall rock
R27962*			H3/929	Chlorite-magnetite
			WARREGO ROCKS	
R27963*			3 level	Quartzose slates & phyllites
R27964*			3 level	Quartzose slates & phyllites
R27965*			8/822/29/178	Quartz-magnetite lode
R27966*			8/822/29/207	Magnetite-pyrite
R27967			8/822/29/243	Massive magnetite
R27968*			8/822/29/333	Magnetite-chalcopyrite
R27969*		GP 280	8/822/29/342	Bismuth lode with marcasite

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R27970		GP 255	8/822/29/243	Bismuth ore
R27971*			8/822/29/382	Quartz-magnetite
R27972*			8/822/29/401	Altered wall rock zone
R27973*			8/822/29/415	Tourmaline wall rock
R27974*			8/822/29/280	Magnetite-quartz
R27975		GP 296	6/824/10/196	Magnetite-pyrite
R27976		GP 278	6/824/10/217	Magnetite-pyrite
R27977			6 level	Magnetite-chalcopyrite
R27978	GT 1455	GP ?	9/816/22/52.8	Magnetite-chlorite-quartz
R27979		GP 574	9/816/22/60.7	Magnetite-chlorite
R27980	GT 1468	GP 573	9/816/22/65.1	Magnetite-chlorite with gold
R27981		GP 587	9/816/22/89.8	Magnetite-chlorite with chalcopyrite
R27982		GP 583	9/816/22/92	Magnetite-chlorite with chalcopyrite
R27983*			8/822/39/108	Quartz-magnetite
R27984	GT 1460		8/816/22/115.2	Muscovite alteration zone
R27985	GT 1481		8/816/22/116	Andalusite alteration zone
R27986*			8/822/29/171	Chloritoid alteration zone
R31711*			8/822/39/321	Quartz porphyroid
R31712			9/816/22/118.5	Altered quartz porphyroid
			EXPLORER 46	
R31713	GT 1357	GP 491	H4/3/307.7	Typical chlorite-sericite shale
R31714	GT 1360	GP 494	H4/3/353.7	Hematite shale
R31715	GT 1361	GP 495	H4/3/362.3	Sandy calcite greywacke
R31716	GT 1362	GP 496	H4/3/378.5	Calcite greywacke
R31717	GT 1364	GP 498	H4/3/383.3	Sandy greywacke
R31718	GT 1363		H4/3/383.2	Coarse lithic wacke
R31719	GT 1386	GP 509	H4/3/439	Dolomite lode
R31720	GT 1384	GP 507	H4/3/443	Dolomite lode
R31721		GP 515	H4/3/446	Pyrite lode
R31722		GP 566	H4/3/451.3	Pyrite-magnetite lode

University N.E. Rock Number	Geopeko Ltd. Thin Section Number	Geopeko Ltd. Polished Section Number	Locality	Lithology
R31723		GP 513	H4/3/454.6	Magnetite-chlorite
R31724		GP 511	H4/3/457.6	Bismuth ore
R31725	GT 1385	GP 508	H4/3/471.6	Calcite-pyrite
R31726		GP 411	Juno, 9/71/14A	Tuffaceous greywacke
R31727	GT 1227		Juno, 9/73/901	Mineralised breccia
R31728	GT 1225		Juno, 9/73/851	Leached silt
R31729	GT 1213	GP 444	Juno, 9/73/238	Leached sediment
R31730	GT 1289	GP 457	Juno, 9/69/516	Mineralised breccia
R31731	GT 1292	GP 460	Juno, 9/69/537	Mineralised breccia
R31732			3/4 km north of Golden Forty Mine	Peko porphyry
R31733	GT 1411		as above	Peko porphyry
R31734	GT 1373		as above	Peko porphyry
R31735			Juno, 7/207/87½	Hematite shale

STUART

WHIPPET

GECKO

ORLANDO

THREE WAYS

BARKLY

HIGHWAY

HIGHWAY

QUARTZ HILL

IVANHOE

GUM RIDGE

JUBILEE

LONE STAR HILL

TENNANT CREEK

PEKO

GOLDEN FORTY

JUNO

NOBLES NOB

5 0 5 10 15 KM

quartz-feldspar porphyries

ection

(interpretive).

Fig (1).

This map will be reduced and simplified & include a locality map of Aust.

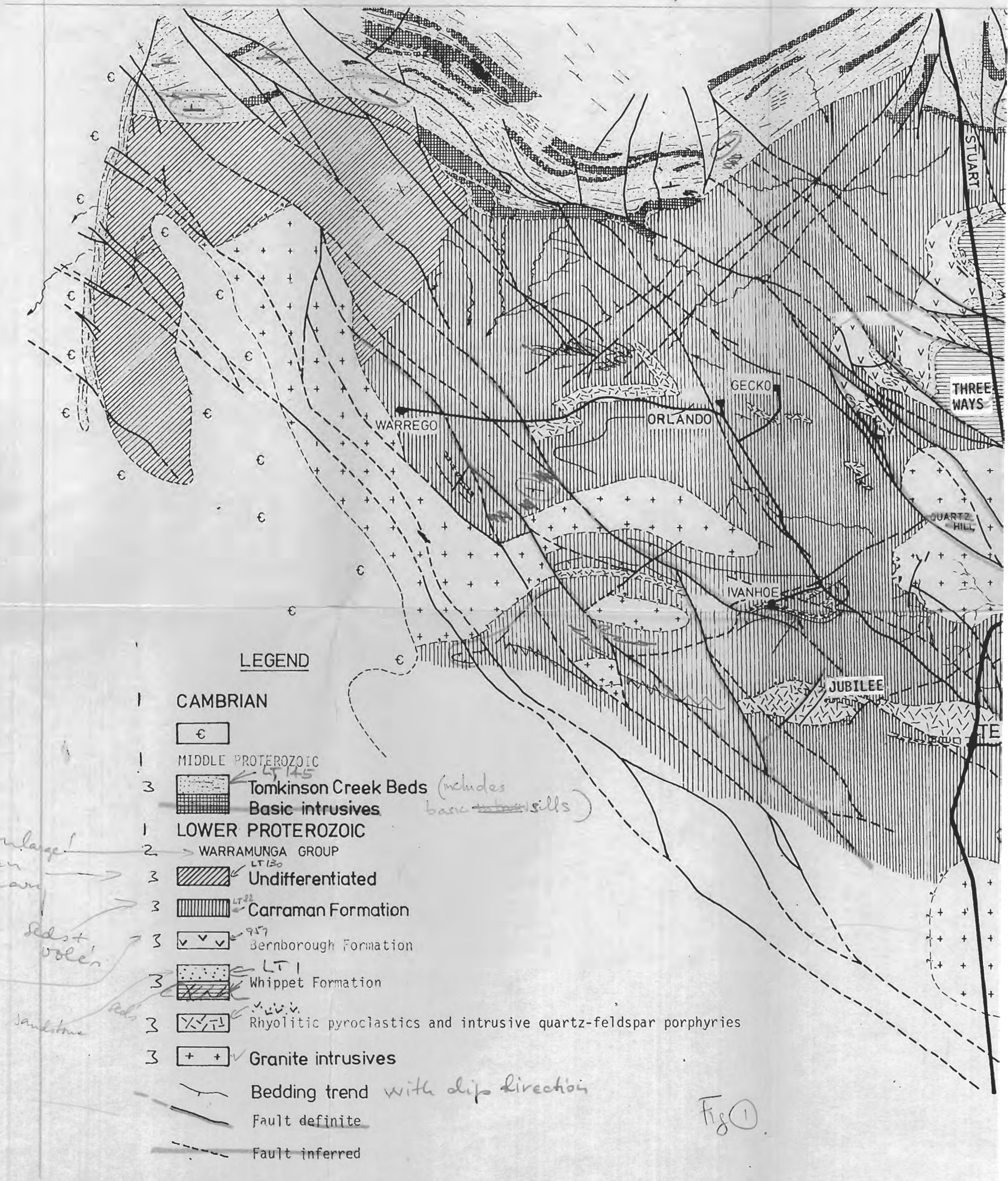

Figure 1.1: - Regional Geology of the Tennant Creek Goldfield (interpretive).
Compiled by Geopeko Ltd.